AASHTOWare BrDR 7.5.0

BrDR Tutorial

CNVRT1 – Converting Girder Line to Girder System Example

BrDR Training

CNVRT1 – Converting Girder Line to Girder System Example

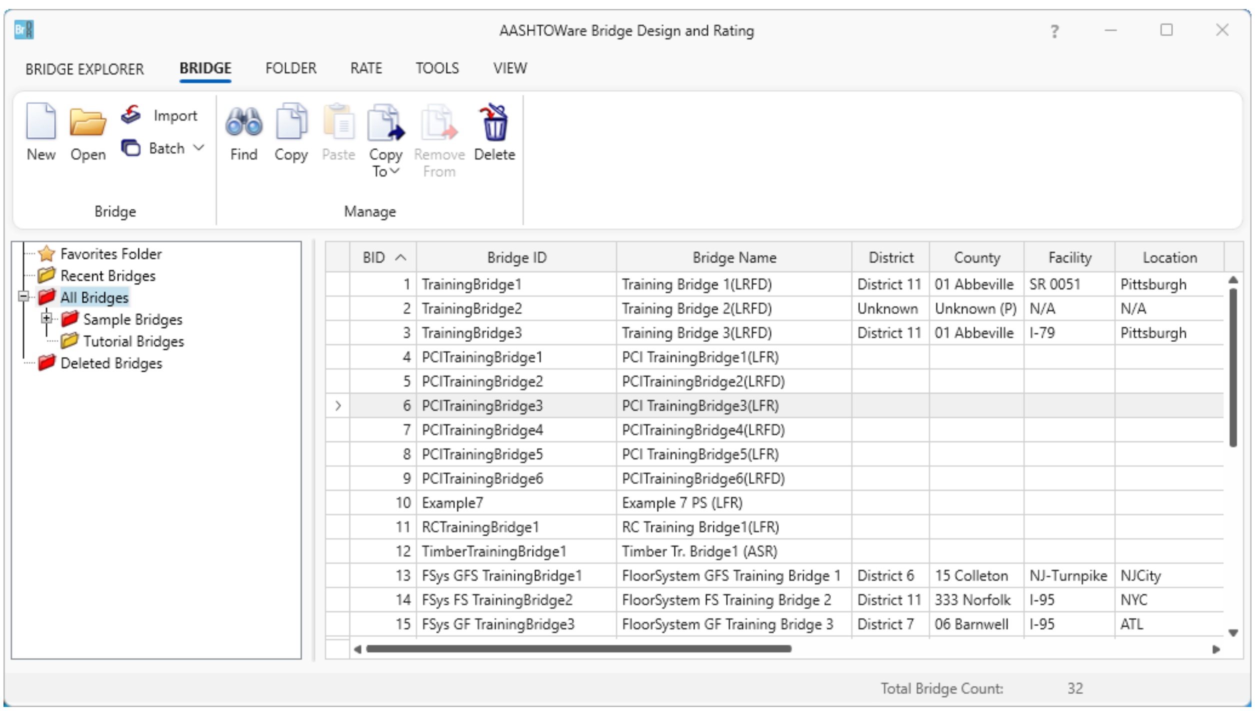
This example illustrates how to convert a girder line superstructure definition to a girder system superstructure definition.

The design plans for the bridge needs to be consulted to obtain the following types of items to convert a girder line to a girder system:

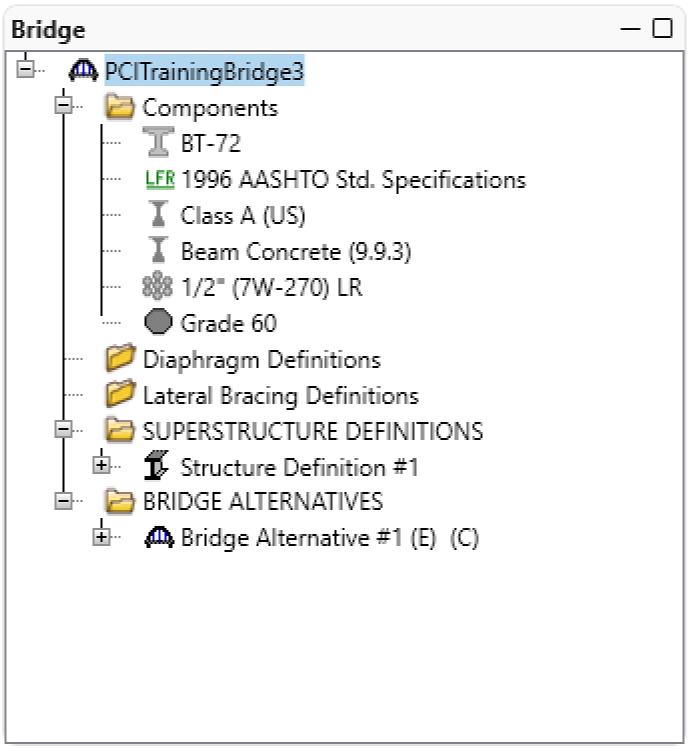
- Overall width of deck, location of travelway lanes, etc.
- Appurtenance dimensions
- Number of girders
- Framing plan skews

Girder System Superstructure definition

In this example **PCITrainingBridge3 (BID 6)** will be converted from a girder line to a girder system structure definition. **PCITrainingBridge3** is a single span prestressed I beam. Select **PCITrainingBridge3** on the right portion of the **Bridge Explorer** and open its **Bridge Workspace** tree.

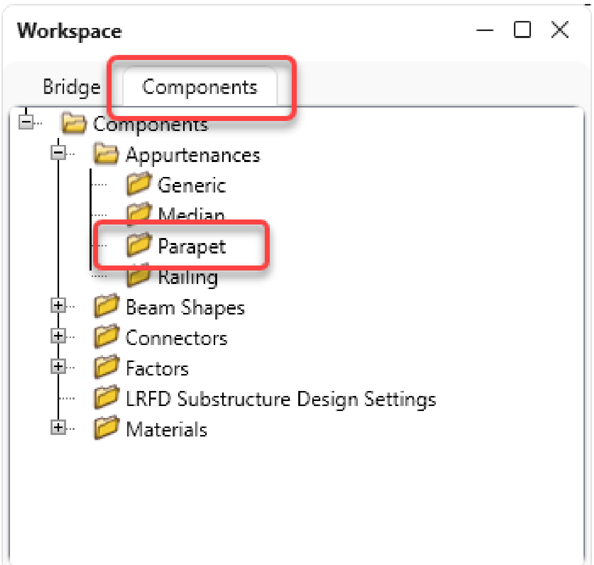


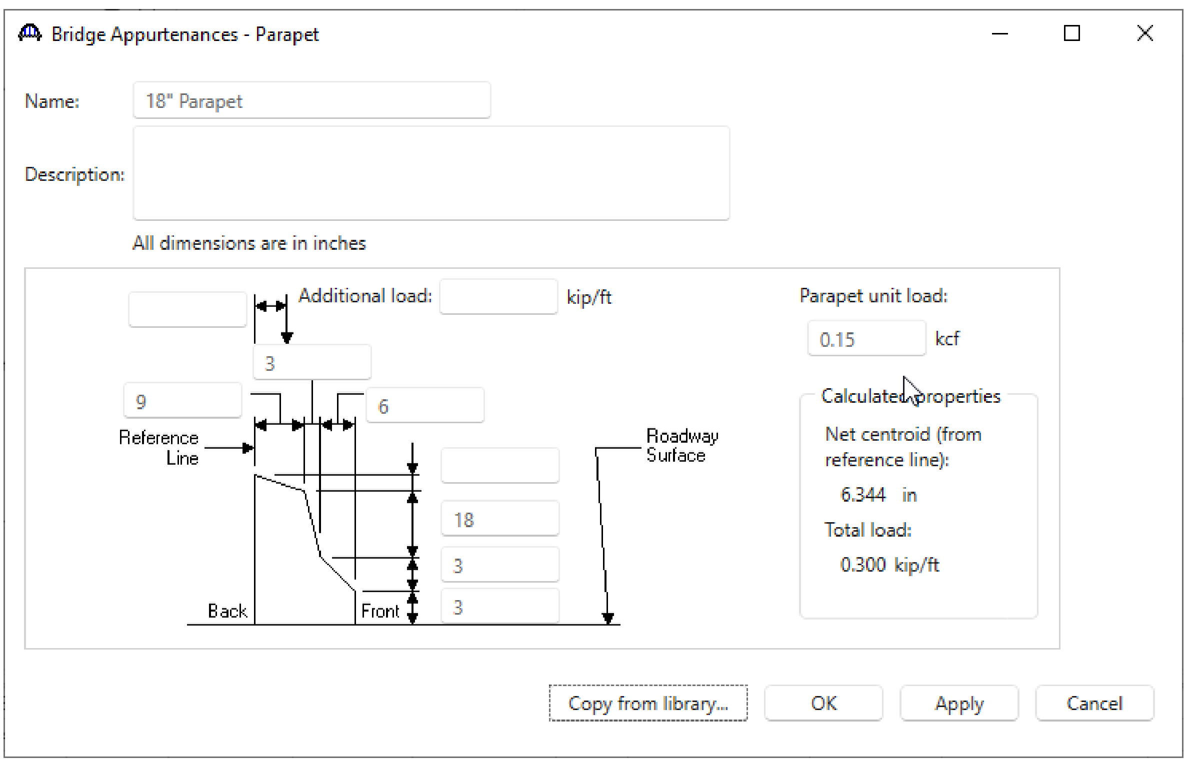
The following view of the expanded **Bridge Workspace** tree shows the materials and beam shapes that currently exist for this bridge. Any superstructure definitions that belong to this bridge will have access to these materials and beam shapes, so materials or beam shapes need not be added again to the bridge to convert this girder line structure definition.



Bridge Appurtenances – Parapet

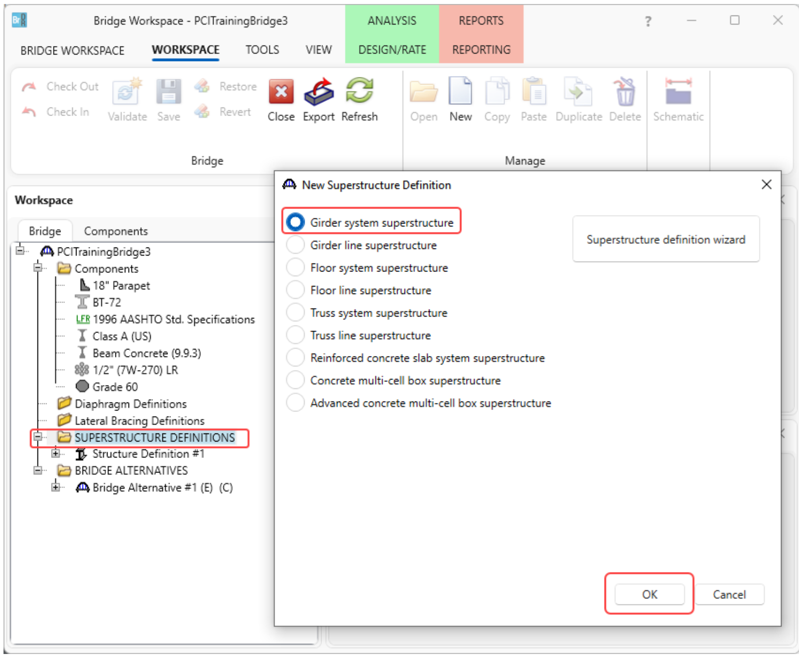
The **Components** listed do not have a parapet. Add a parapet to this bridge by selecting the **Components** tab, right clicking **Parapet** in the Components Workspace tree, and selecting **New** from the **WORKSPACE** ribbon. Enter the following data to describe the parapet and click **OK**.



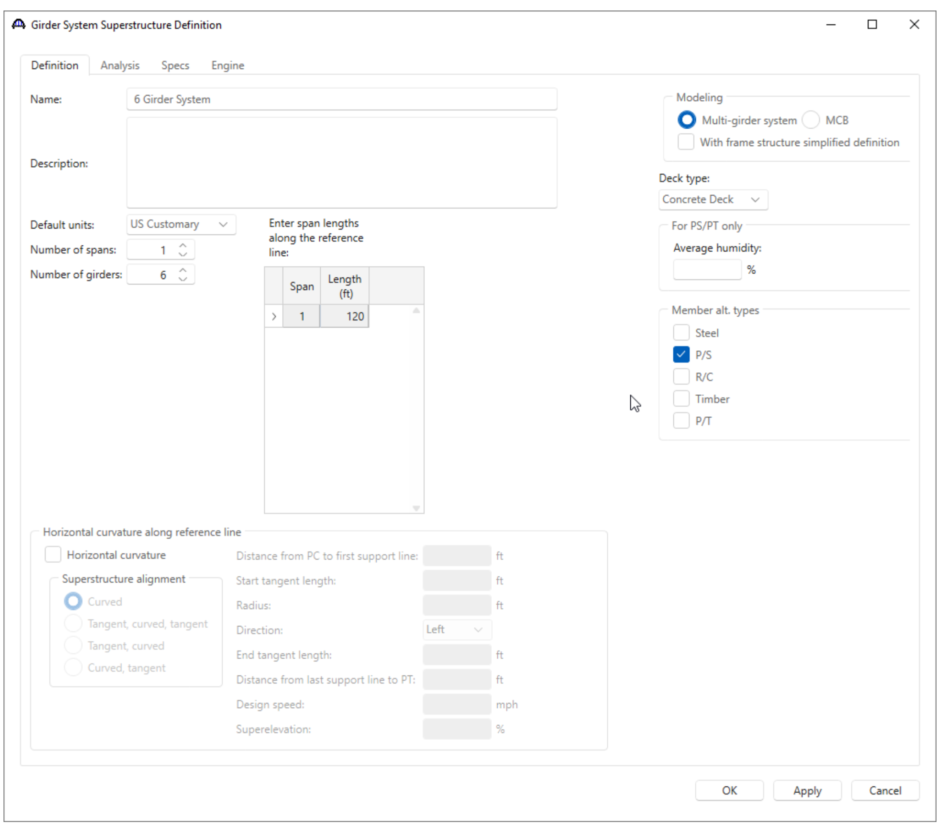


Girder System Superstructure Definition

Now create a new **Girder System Superstructure Definition** by double clicking on **SUPERSTRUTURE DEFINITIONS** and selecting **Girder system superstructure**.



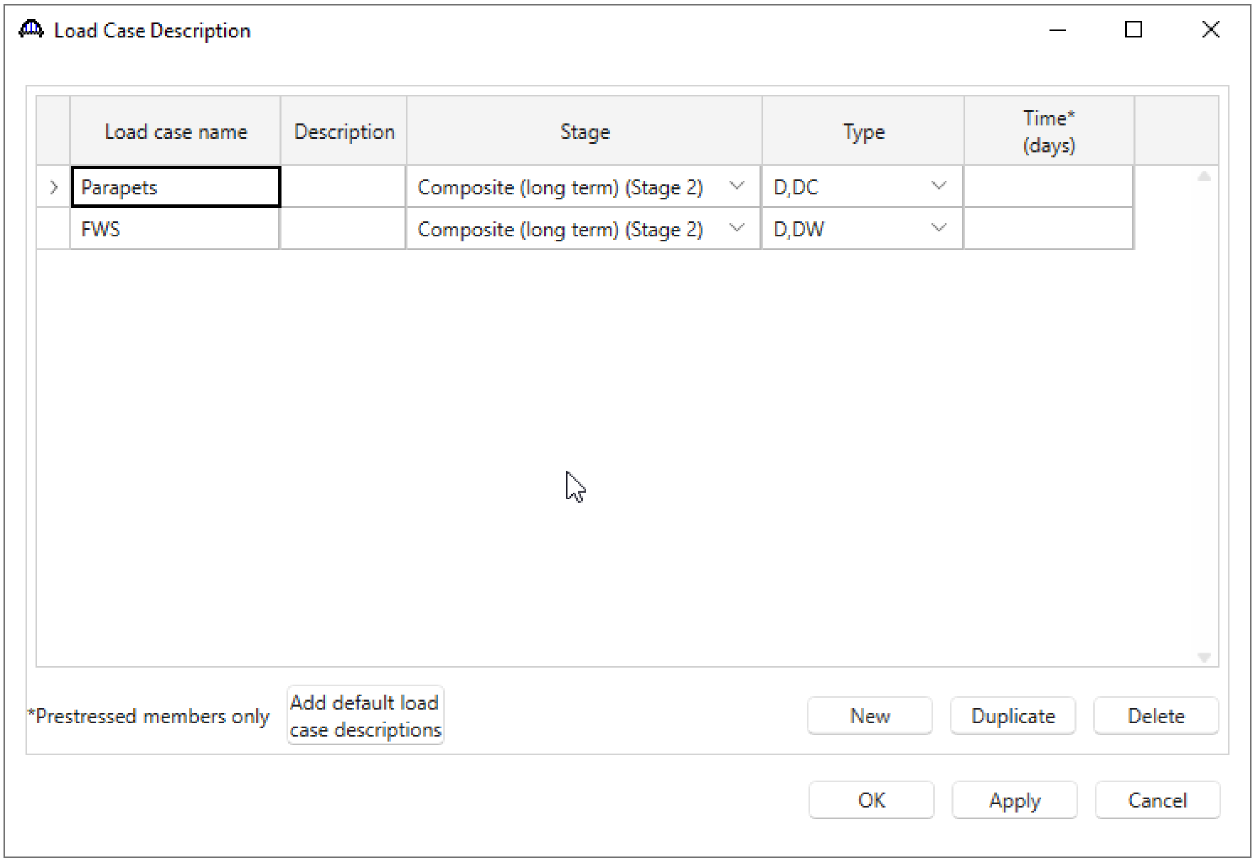
The window shown below opens. Enter the following data and click **OK**.



As data is entered for the new girder system superstructure definition, open the windows for the original girder line superstructure definition to determine if there is data that needs to be copied from the original girder line superstructure. The Average Humidity on the superstructure definition window is an example of such data. Open the **Structure Definition #1** girder line window to determine that the original superstructure does not have any data for that item. If it did, copy that data to the new girder system superstructure definition.

Load Case Description

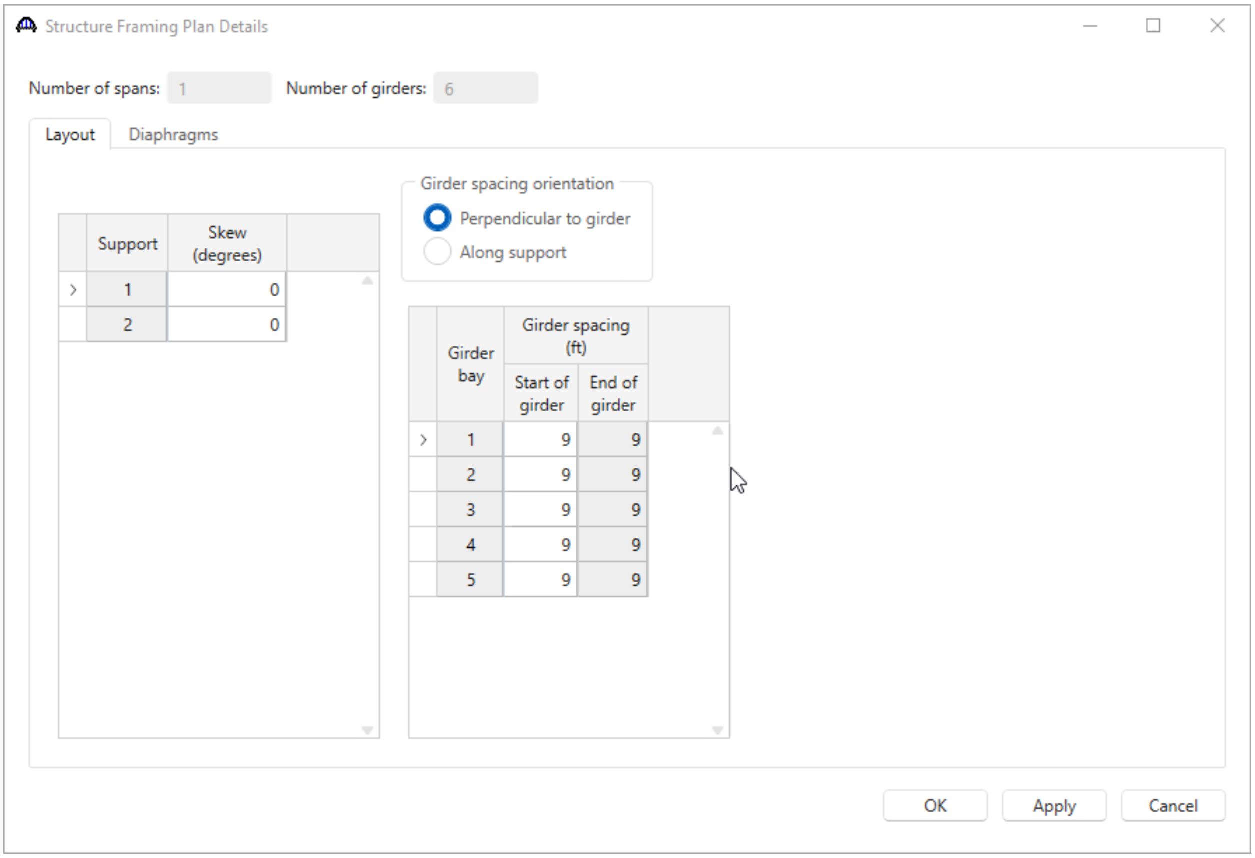
Now add Load Case Descriptions to the new superstructure definition. Open the **Load Case Description** for the original girder line **Structure Definition #**1 by double clicking on the **Load Case Description** node under **Structure Definition #**1 superstructure definition. The following window will be presented.



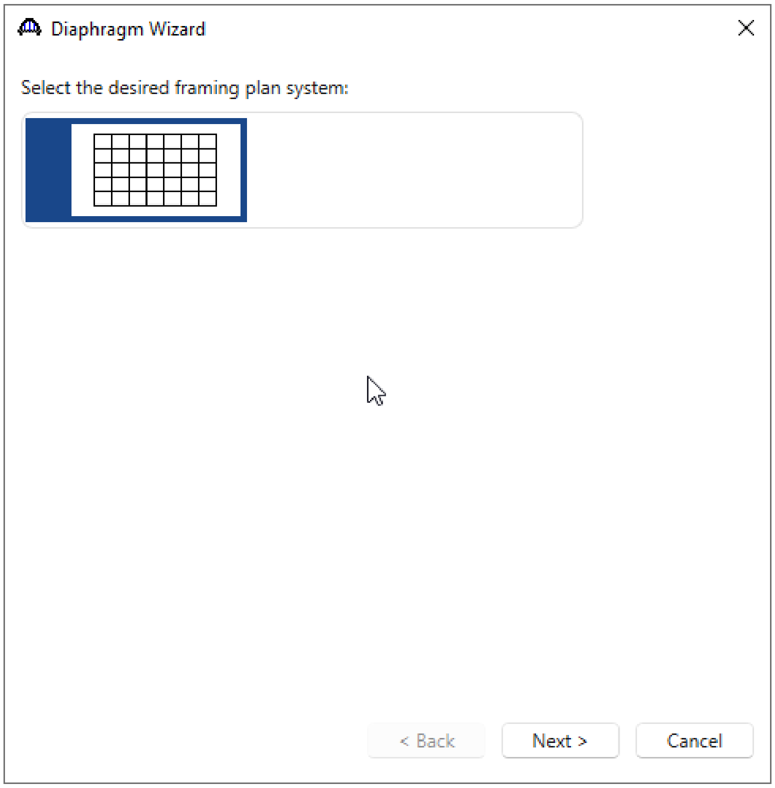
Now open the **Load Case Description** window belonging to the new **6 Girder System** superstructure definition and enter these same load cases. Click the **OK** button to save these load cases to the new superstructure definition and close the window.

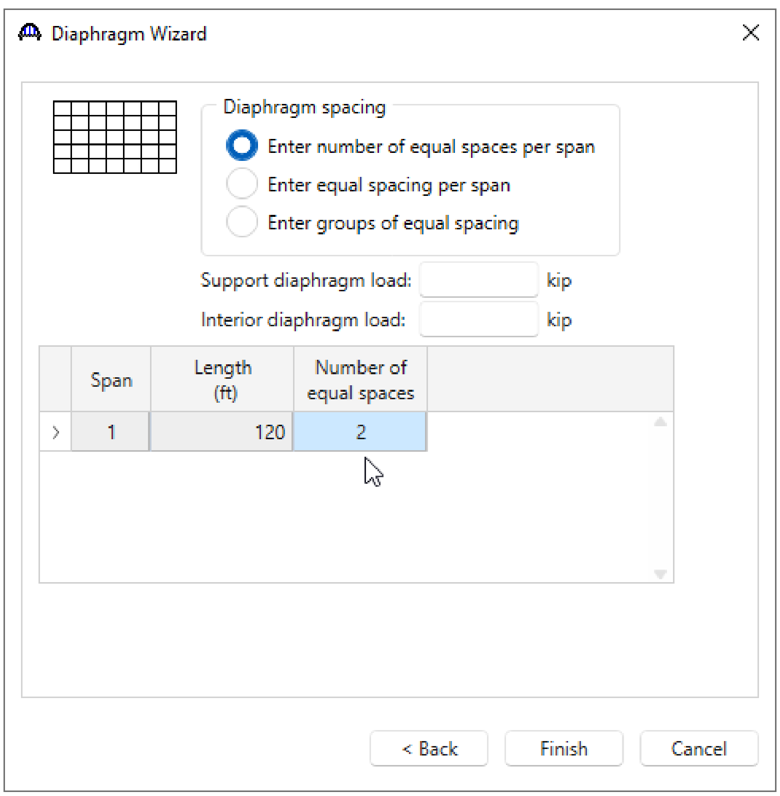
Framing Plan Detail

Open the **Structure Framing Plan Details** window for the **6 Girder System** and enter the following data under **Layout** tab.



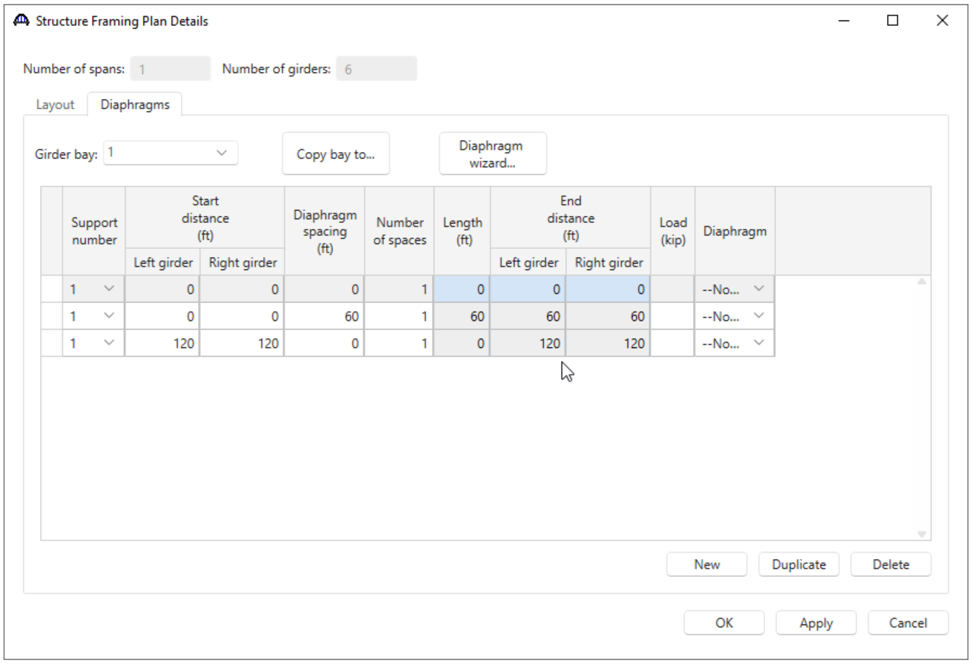
Navigate to the **Diaphragms tab** and use the **Diaphragm Wizard** to create the diaphragms as shown below.





Click on the **Finish** button to close this window and create the diaphragms.

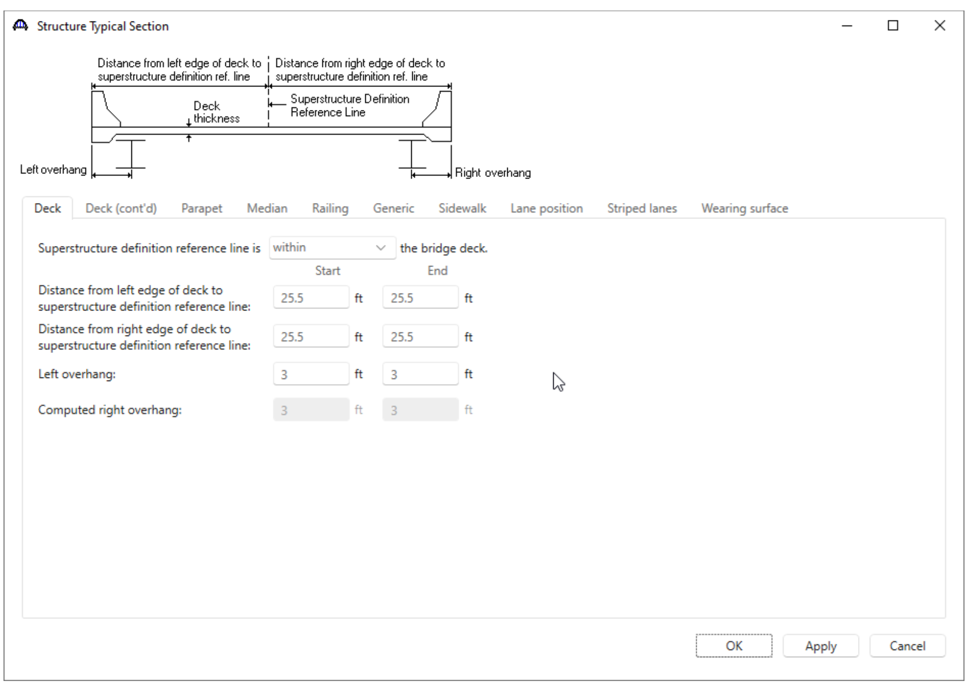
The updated **Structure Framing Plan Details** window is shown below.



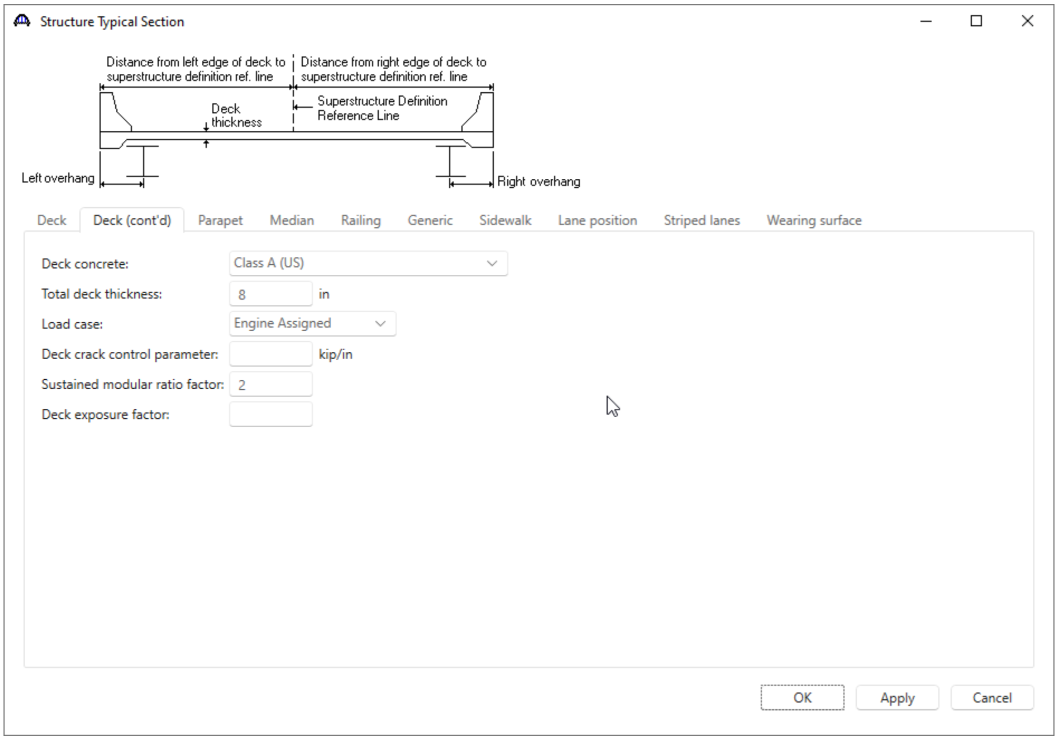
(Note: PCITrainingBridge3 as delivered in the sample database does not have any diaphragms entered in the Bracing Ranges window for Member Alternative **Member Alternative #1 (9.9.3)**. That is in error, it should have diaphragms.)

Structure Typical Section

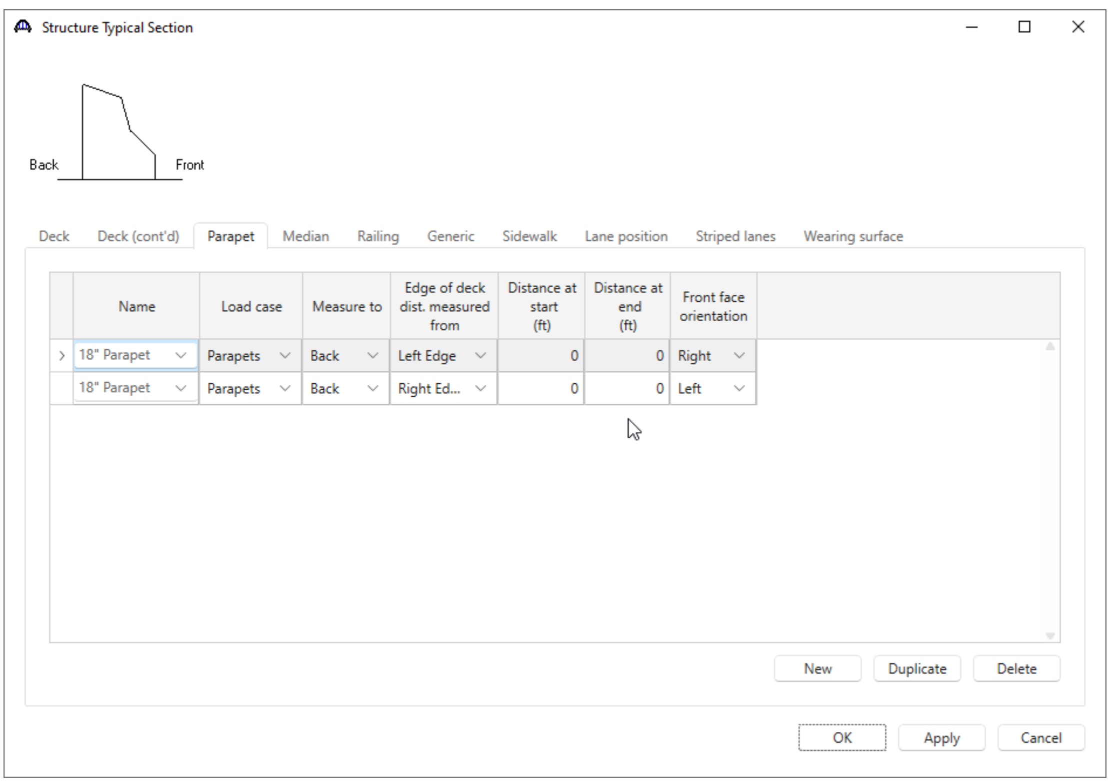
Open the **Structure Typical Section** window for **6 Girder System** and enter the following on the **Deck tab**.



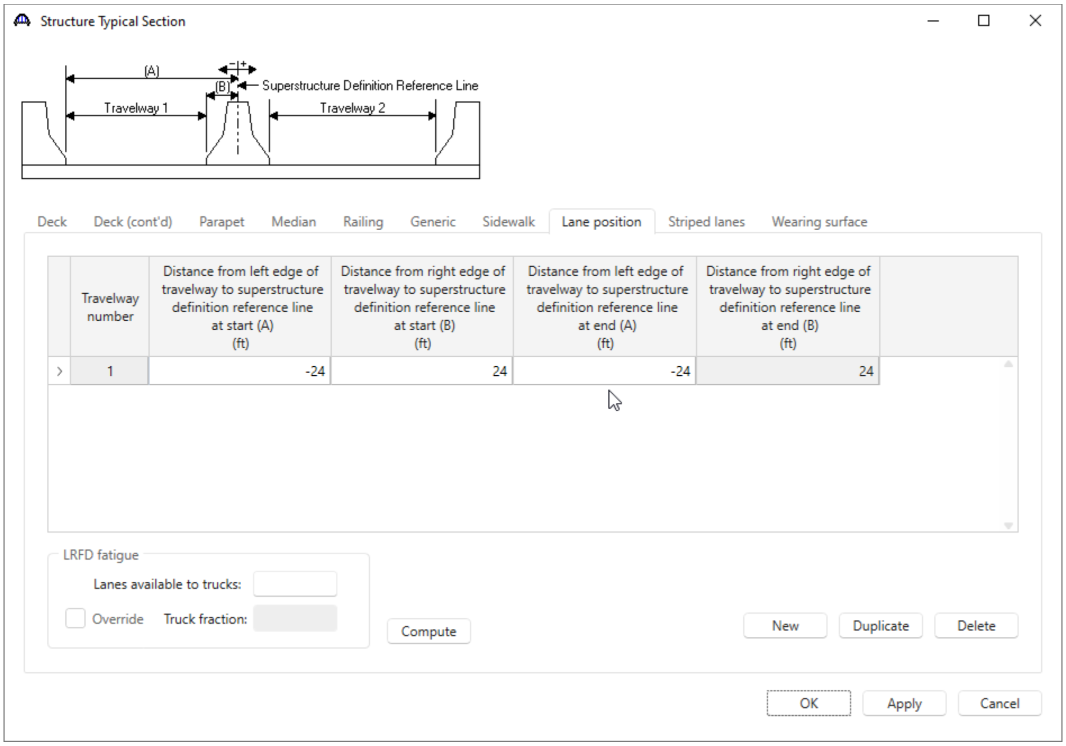
Next, select the **Deck (cont'd)** tab and enter the following.



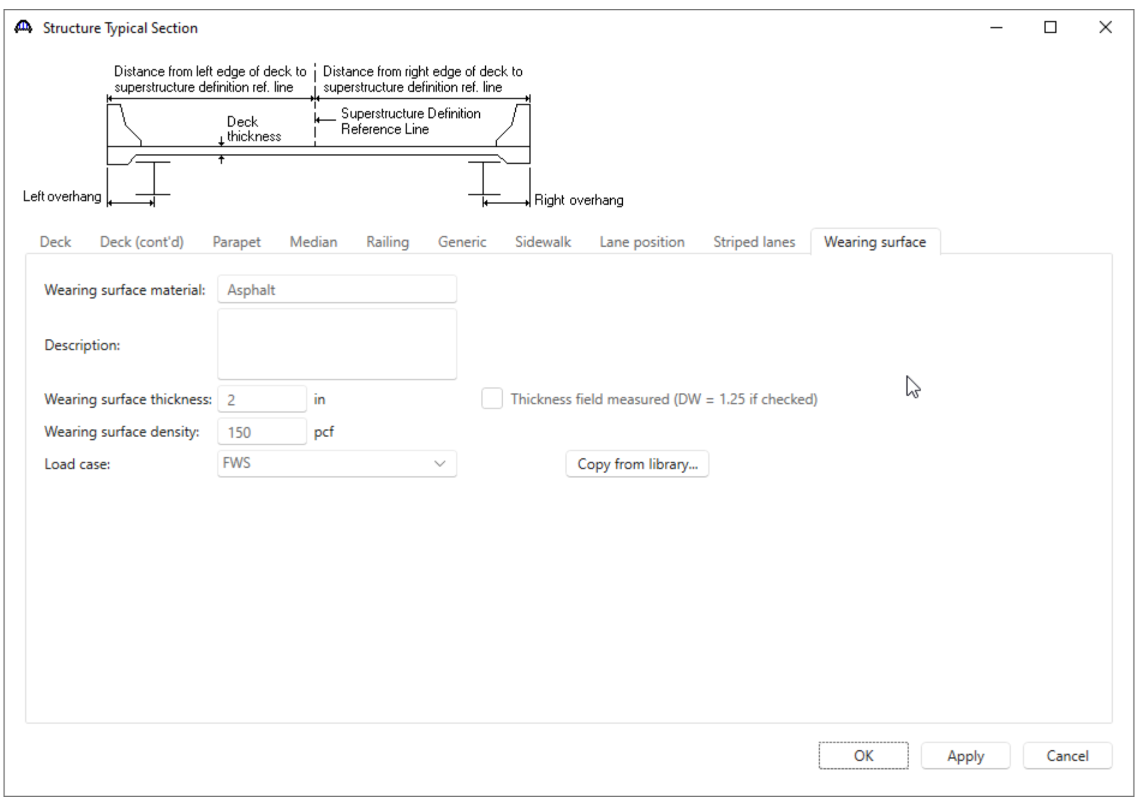
The parapet locations are entered as follows on the **Parapet** tab.



Open the **Lane position** tab and use the **Compute** button to compute the travelway locations.



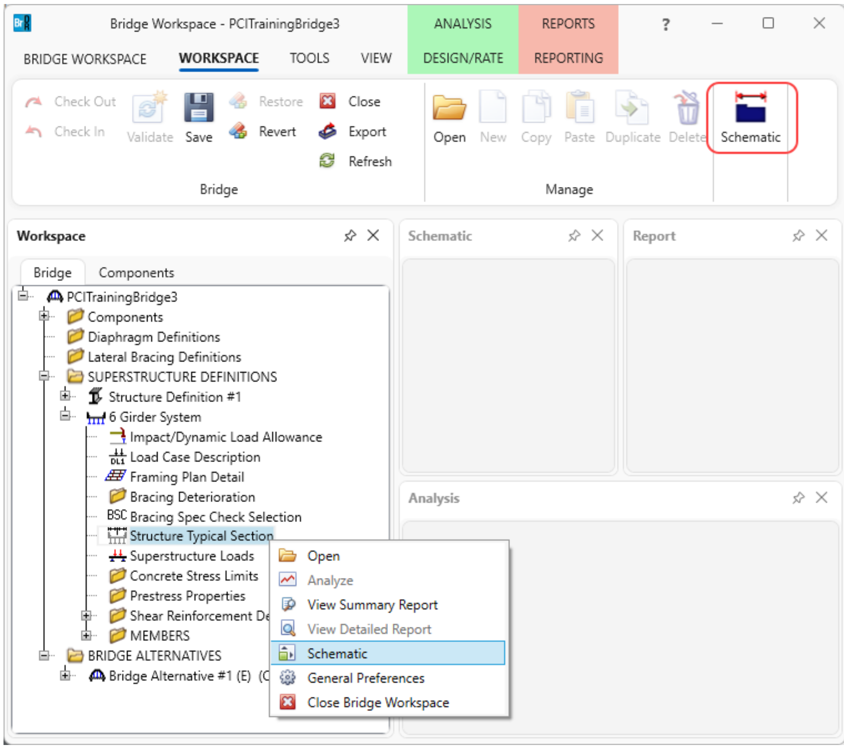
Enter the wearing surface data as follows on the **Wearing surface** tab.



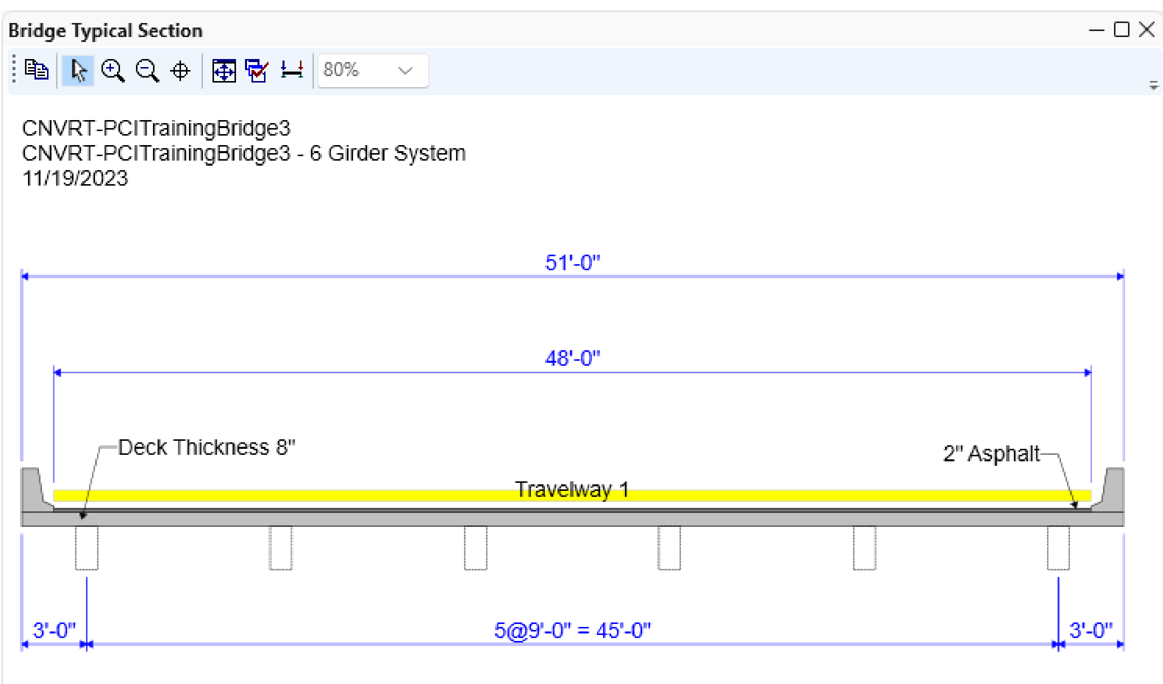
Click **OK** to apply the data and close the window.

Schematic – Structure Typical Section

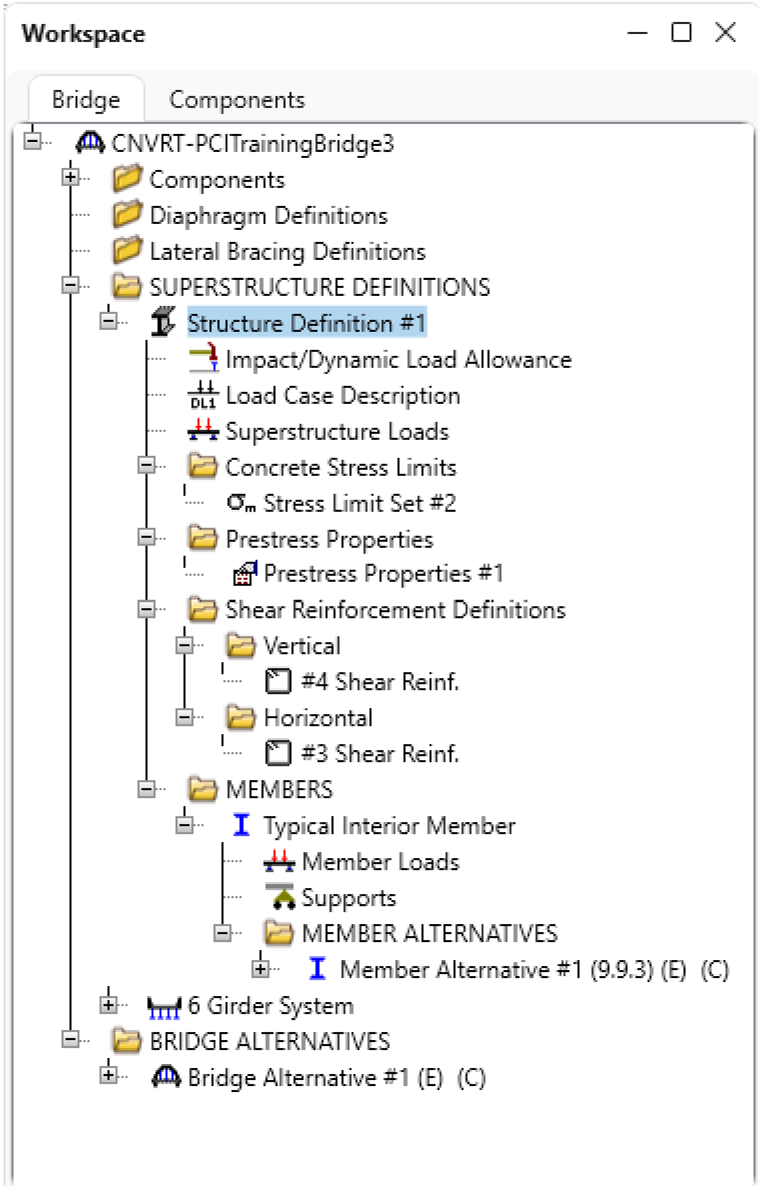
Now view the schematic for the **Structure Typical Section** for **6 Girder System** by selecting **Structure Typical Section** node in the **Bridge Workspace** tree and clicking the **Schematic** button on the **WORKSPACE** ribbon (or right clicking and selecting **Schematic**).



The schematic is shown below.



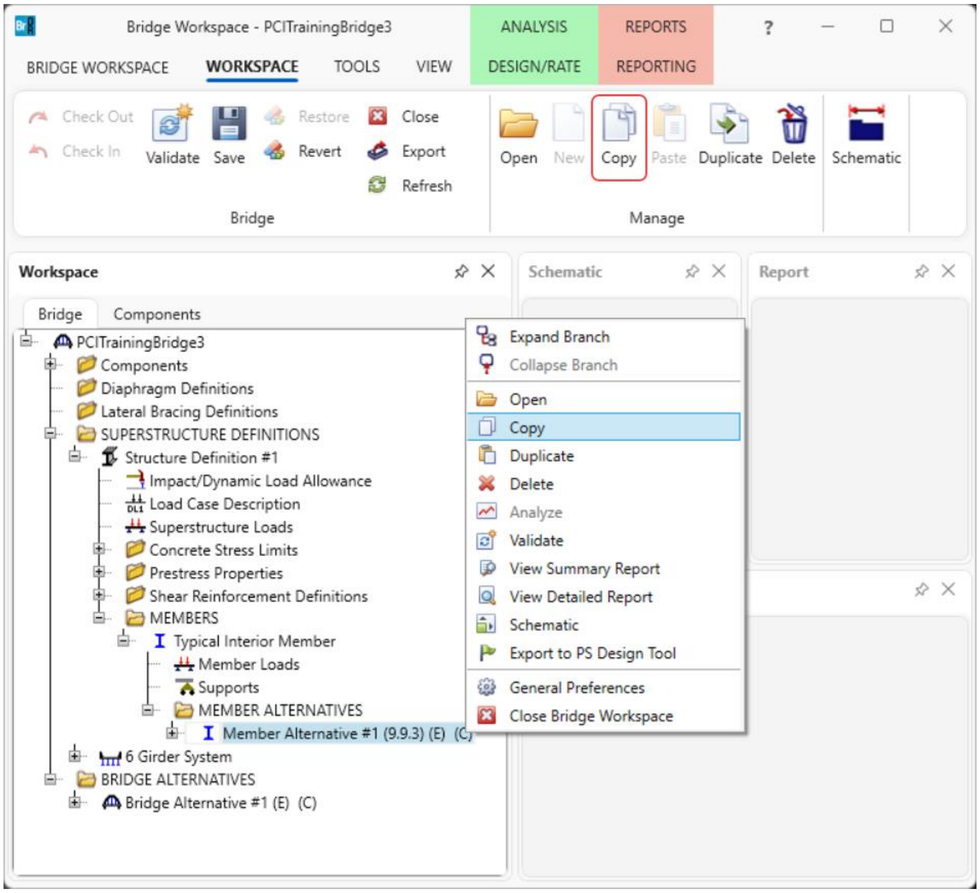
Expand the **Bridge Workspace tree** for the original girder line **Structure Definition #1**.



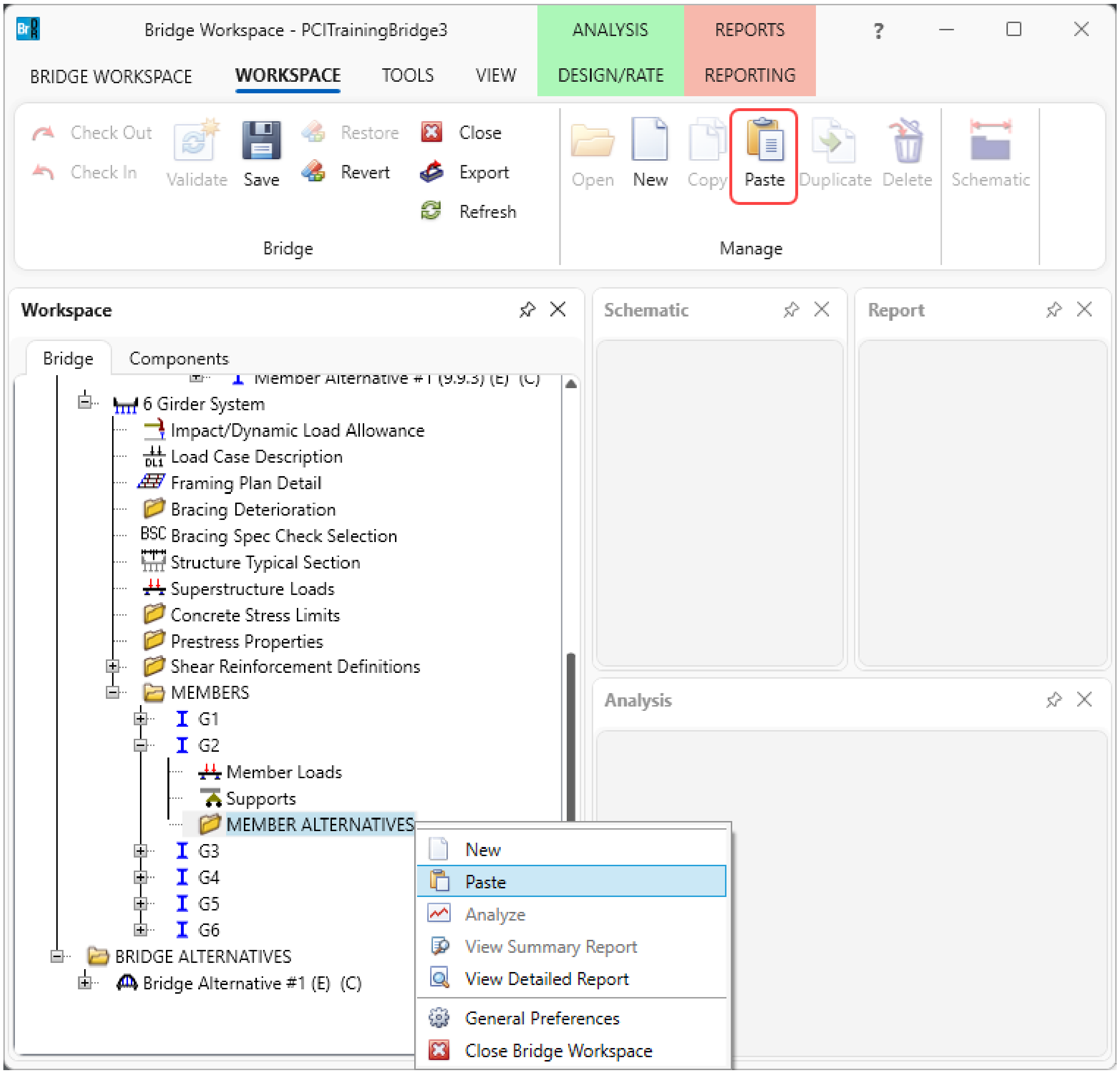
This structure already has data defined for the Stress Limits, Prestress Properties and Shear Reinforcement Definitions. It also has a Member Alternative for an interior member. The Member Alternative can be copied from this original superstructure definition to the new **6 Girder System** superstructure definition. When the Member Alternative is copied, the Stress Limits, Prestress Properties and Shear Reinforcement definitions belonging to the girder line superstructure will also be copied.

Member Alternative

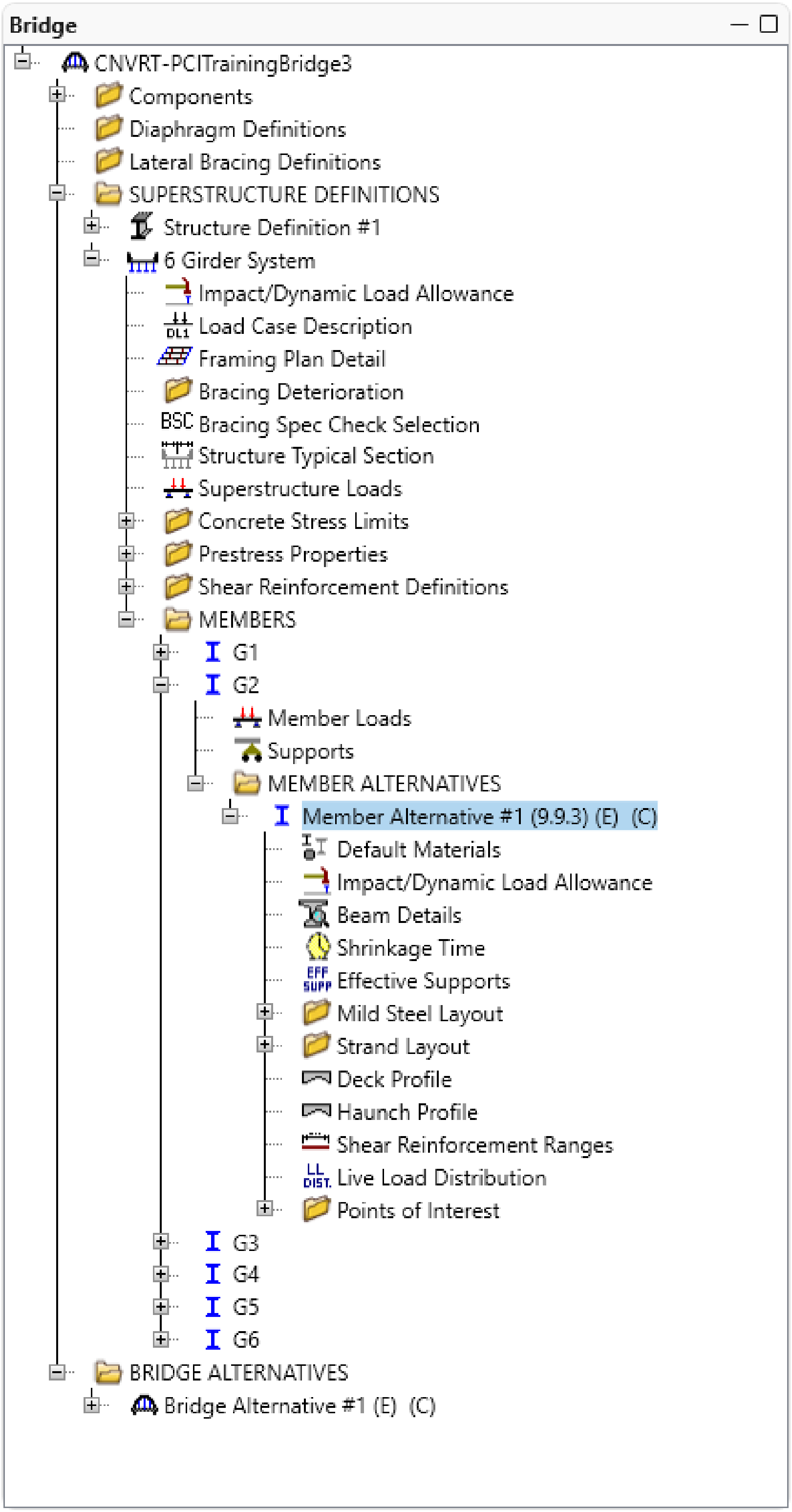
Select **Member Alternative #1 (9.9.3)** in the tree and right click and select **Copy** from the menu (or select **Copy** from the **Manage** group of the **WORKSPACE** ribbon.



Now select **MEMBER ALTERNATIVES** under the Member **G2** in the **6 Girder System** superstructure definition, right click and select **Paste** (or select **Paste** from the **Manage** group of the **WORKSPACE** ribbon).



A copy of **Member Alternative #1 (9.9.3)** will now appear under Member **G2** in the **6 Girder System Bridge Workspace** tree. The Stress Limit, Prestress Properties, and Shear Reinforcement Definitions will also now appear under the **6 Girder System Bridge Workspace** tree.



Member Loads

Now check for differences between the original girder line member and the new girder system member. Open the **Member Loads** window for **Typical Interior Member** for **Structure Definition #1** and review the data on it to determine if any data such as the **Pedestrian Load** should be entered for the new **G2** member. Similar data needs to be reviewed in many locations. Open each window or use the **Report Tool** to compare the data.

There are two choices to handle how the dead loads will be entered and distributed in the new girder system superstructure definition. The method chosen will depend on the original girder line member's Member Load data and the number of calculations needed to perform.

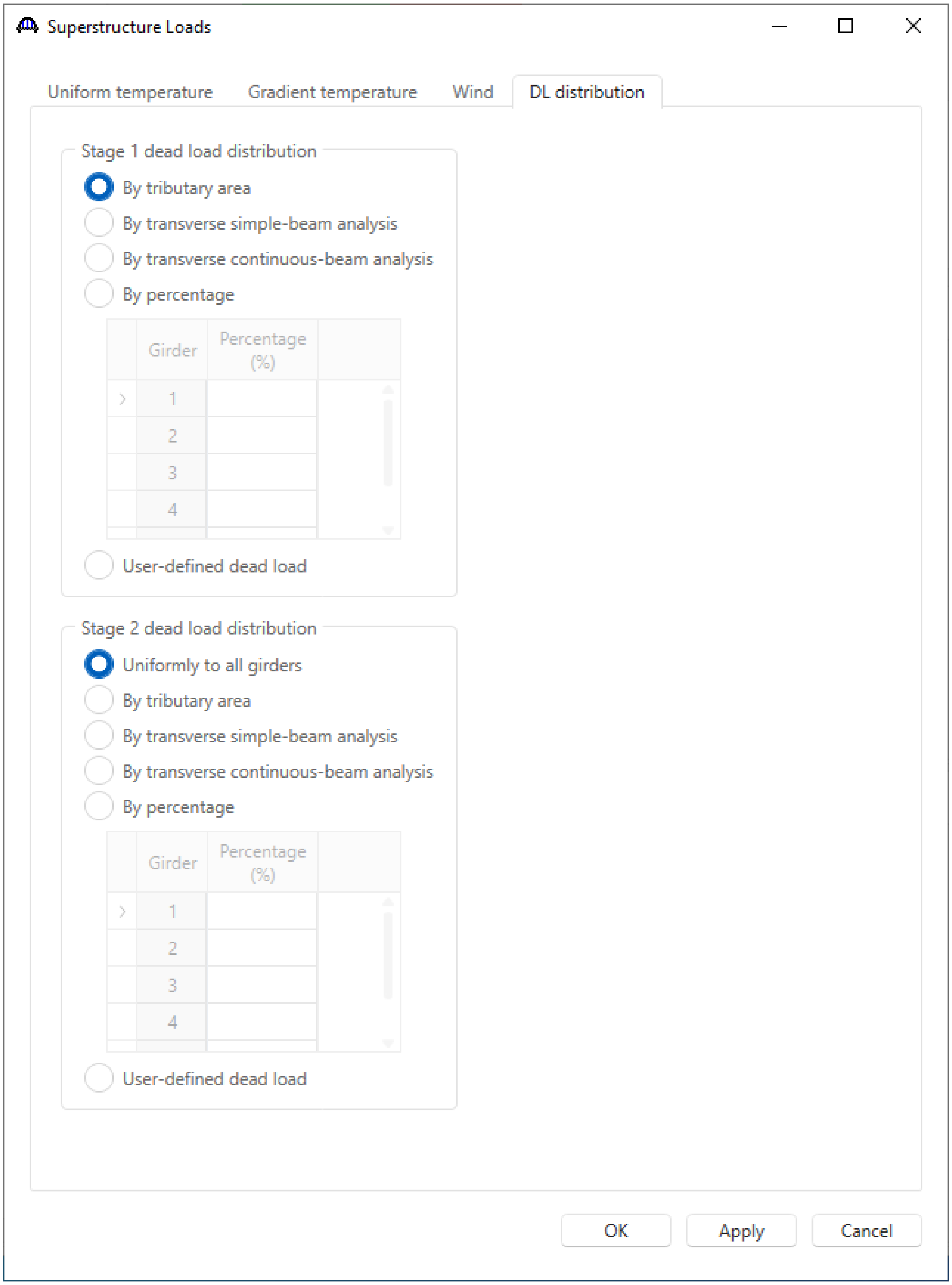
Method 1: Let BrDR compute and distribute the superstructure load. Some additional loads will need to be computed that should be applied to the members (stay-in-place forms, e.g.). Some of these loads may already be entered for the original girder line member lumped together with parapet loads, etc. It may take some computations to determine what portion of the original girder line member loads is due to loads that can be computed and distributed by BrDR.

Method 2: Tell BrDR not to compute and distribute the deck load. Copy the original girder line Member Loads to the new girder system member. Dead load due to the deck slab that acts on that particular girder will need to be computed and entered as a member load for the new girder system member.

Following Method 1 first in this example.

Superstructure Loads (Using Method 1 of adding member loads)

Method 1: In a girder system superstructure, BrDR will determine the dead load due to the deck slab and appurtenances located on the deck. BrDR uses the data on the **Superstructure Loads** window to determine how to distribute this dead load.



Open the **Member Loads** window for the original girder line member and review the data on that window. This original member has two uniform load cases, one for the **FWS** load case and one for the **Parapets** load case. For this example, these loads are easily verifiable with the data entered on the **Structure Typical Section** window.

FWS (Future Wearing Surface): $0.2k / ft = \frac{\left(\frac{2''}{12}\right)(48')(0.150kcf)}{6girders}$

Parapets: $0.1k / ft = \frac{2 * 0.3klf}{6girders}$

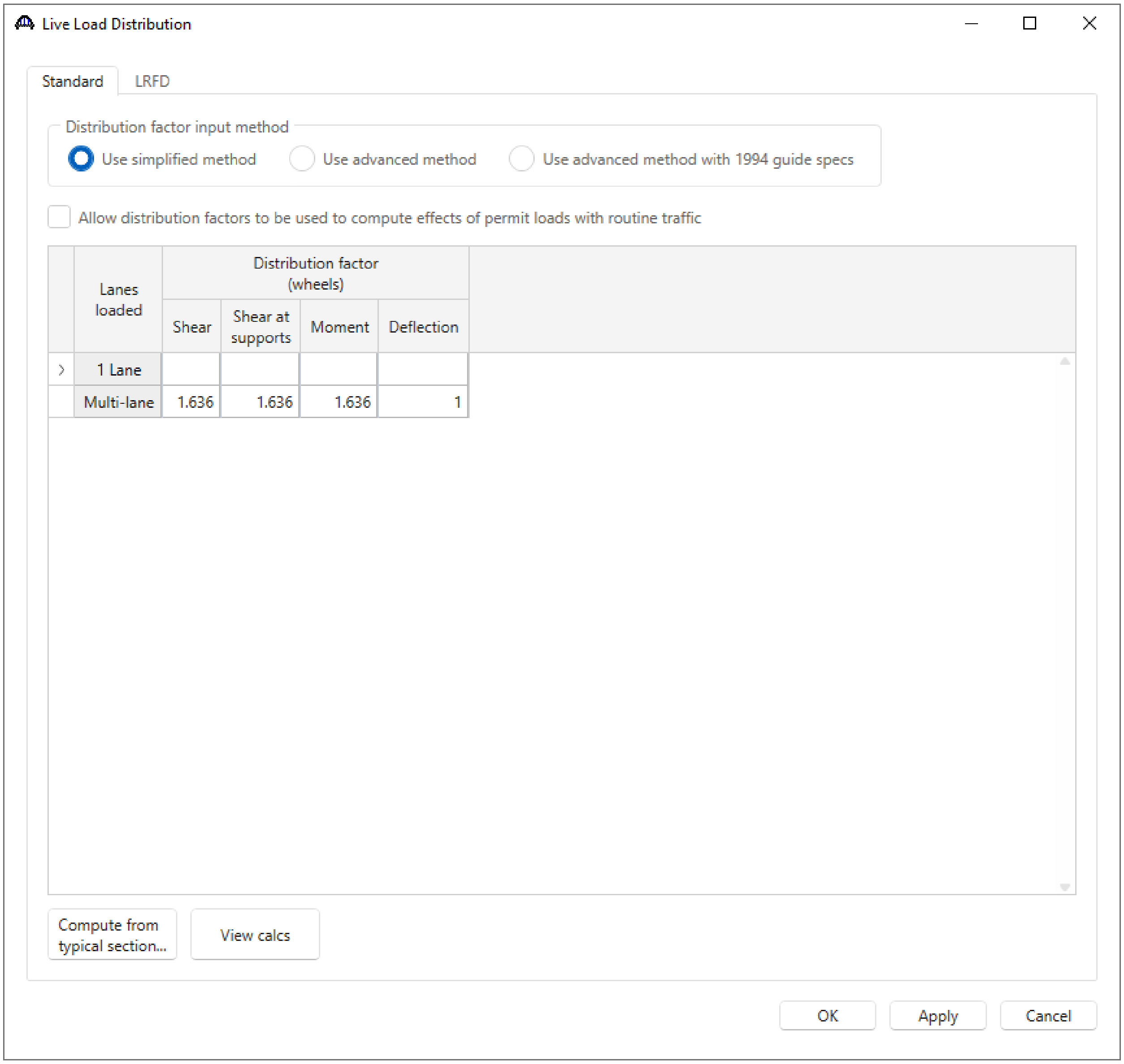
For the girder system superstructure, the future wearing surface load and parapet load applied to each member will be computed by BrDR based on the data entered in the **Structure Typical Section** window. Therefore, no data needs to be entered in **Member Loads** for the new girder system members. For this example, determining the source of the original girder line Member Loads was easy. If the original girder line member was imported from BARS, it may not be as easy to determine what portion of the Member Load is due to the deck slab, appurtenances and wearing surface. Perform some investigation and calculations to determine what member loads should enter into BrDR for new girder system members when converting existing girder line members.

Supports

Open the **Supports** window for the original girder line member to see if any data should be copied to the new girder system members.

Live Load Distribution

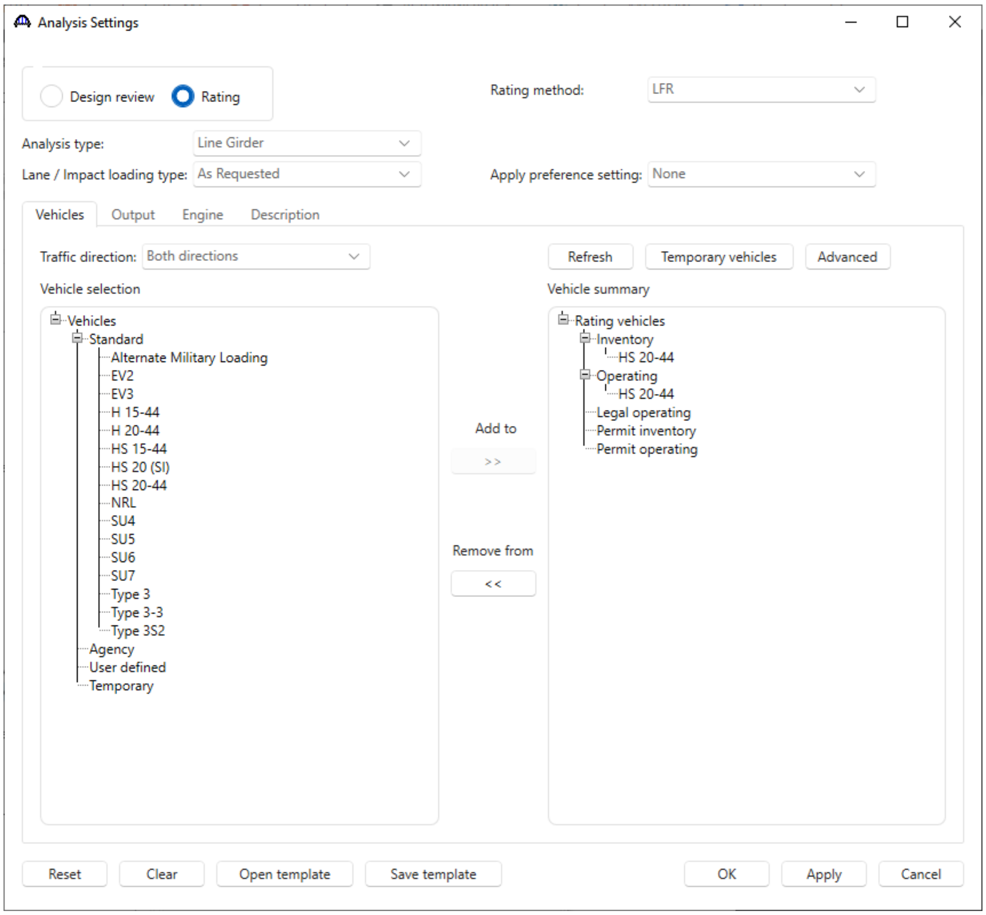
The **Live Load Distribution** window for the new girder system member alternative contains the following data based on being copied from the original girder line member alternative. This data can remain or the **Compute from Typical Section** option can be used to update these values now that the travelways are in relation to the girder member location.



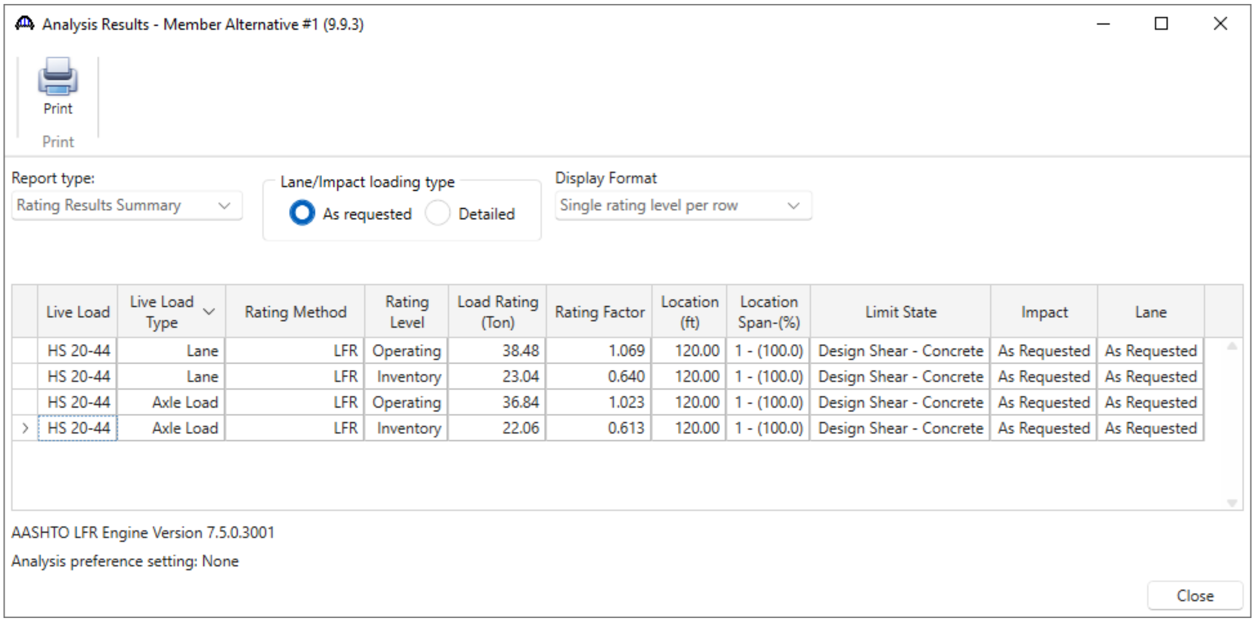
The data in the remaining windows under the girder member alternative should be acceptable based on being copied from the girder line member alternative.

LFR Analysis – Results Comparison – (Using Method 1 of adding member loads)

On performing an **LFR** analysis using the **Analysis settings** shown below, the following two windows show a comparison of the rating factors obtained for the original girder line and the new girder system member alternatives.

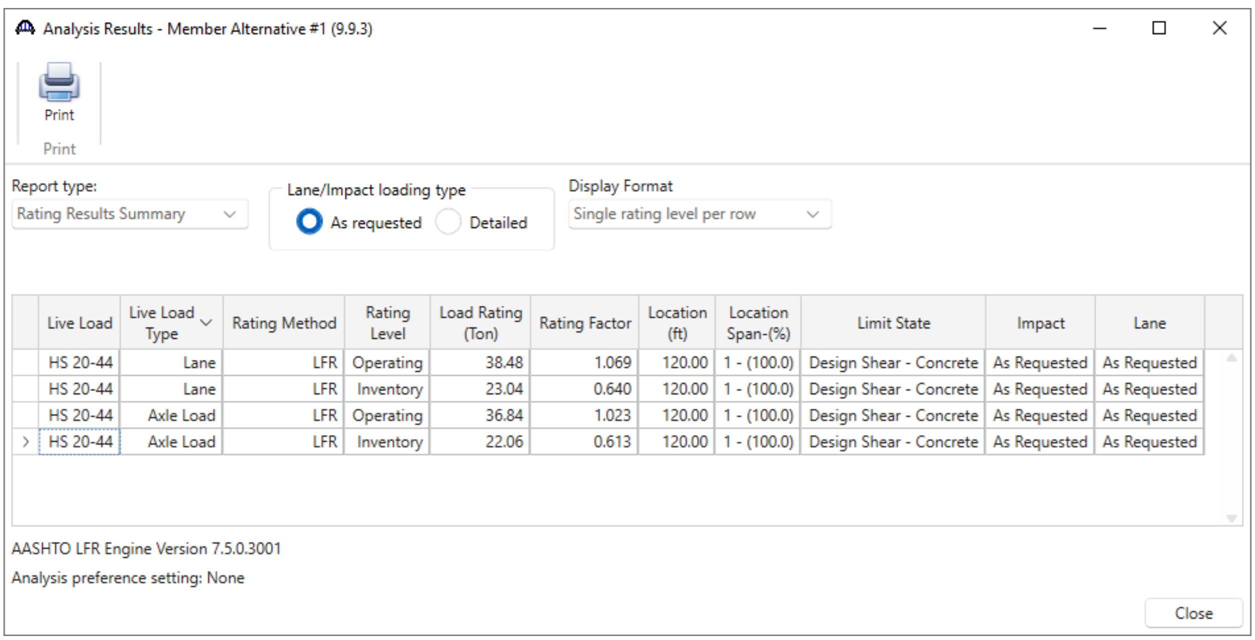


Original girder line member alternative **(Structure Definition #1)**



Live Load	Live Load Type	Rating Method	Rating Level	Load Rating (Ton)	Rating Factor	Location (ft)	Location Span-(%)	Limit State	Impact	Lane
HS 20-44	Lane	LFR	Operating	38.48	1.069	120.00	1 - (100.0)	Design Shear - Concrete	As Requested	As Requested
HS 20-44	Lane	LFR	Inventory	23.04	0.640	120.00	1 - (100.0)	Design Shear - Concrete	As Requested	As Requested
HS 20-44	Axle Load	LFR	Operating	36.84	1.023	120.00	1 - (100.0)	Design Shear - Concrete	As Requested	As Requested
HS 20-44	Axle Load	LFR	Inventory	22.06	0.613	120.00	1 - (100.0)	Design Shear - Concrete	As Requested	As Requested

Newly copied girder system member alternative **(6 Girder System)**



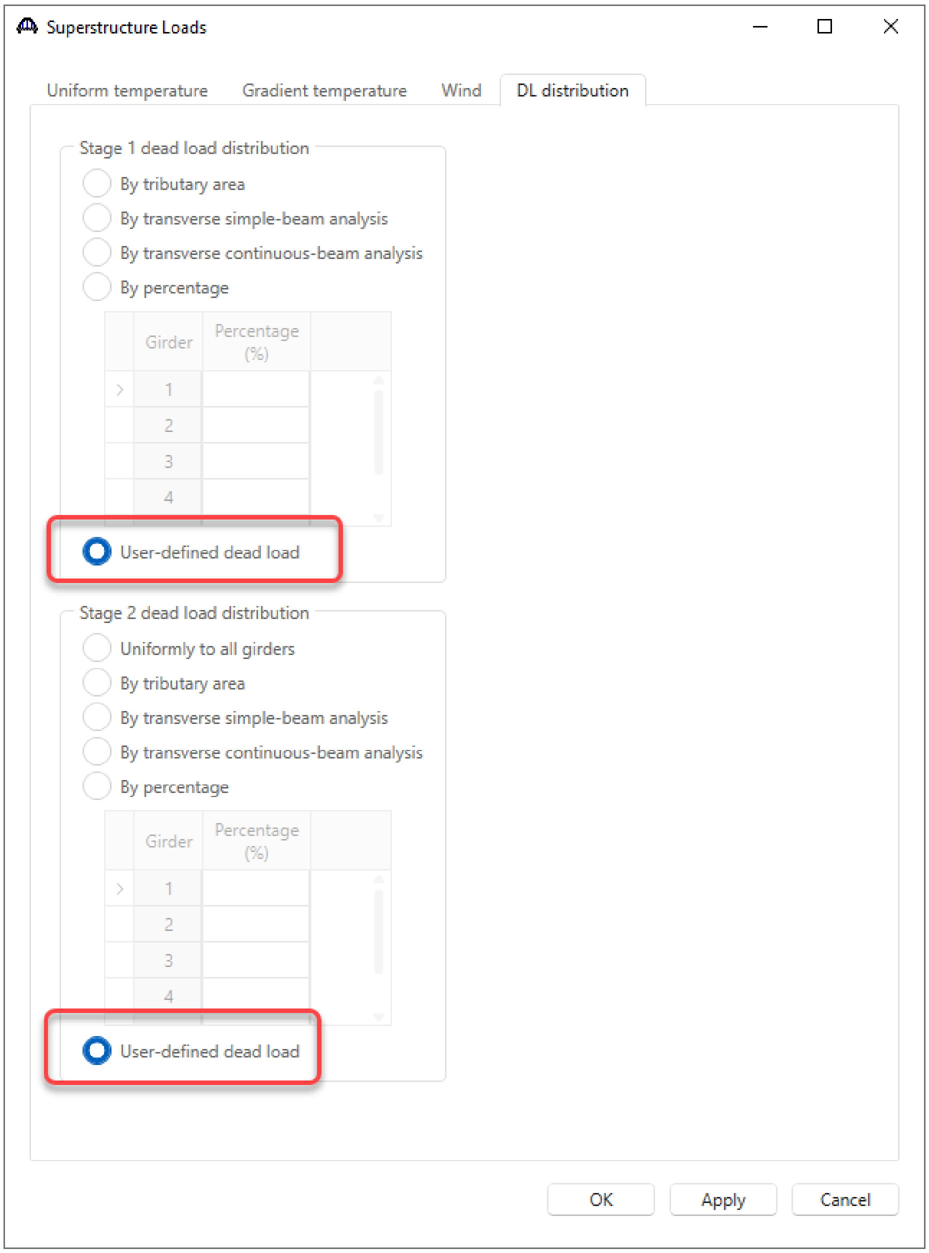
Live Load	Live Load Type	Rating Method	Rating Level	Load Rating (Ton)	Rating Factor	Location (ft)	Location Span-(%)	Limit State	Impact	Lane
HS 20-44	Lane	LFR	Operating	38.48	1.069	120.00	1 - (100.0)	Design Shear - Concrete	As Requested	As Requested
HS 20-44	Lane	LFR	Inventory	23.04	0.640	120.00	1 - (100.0)	Design Shear - Concrete	As Requested	As Requested
HS 20-44	Axle Load	LFR	Operating	36.84	1.023	120.00	1 - (100.0)	Design Shear - Concrete	As Requested	As Requested
HS 20-44	Axle Load	LFR	Inventory	22.06	0.613	120.00	1 - (100.0)	Design Shear - Concrete	As Requested	As Requested

The newly created member alternative for Member **G2** can now be copied to or linked with the other members in the **6 Girder System** superstructure definition. After copying this interior member alternative to one of the exterior members, the **Live Load Distribution** Factors and **Haunch** windows needs to be revisited to enter the correct data for an exterior member.

Now use Method 2 to enter the loads in BrDR.

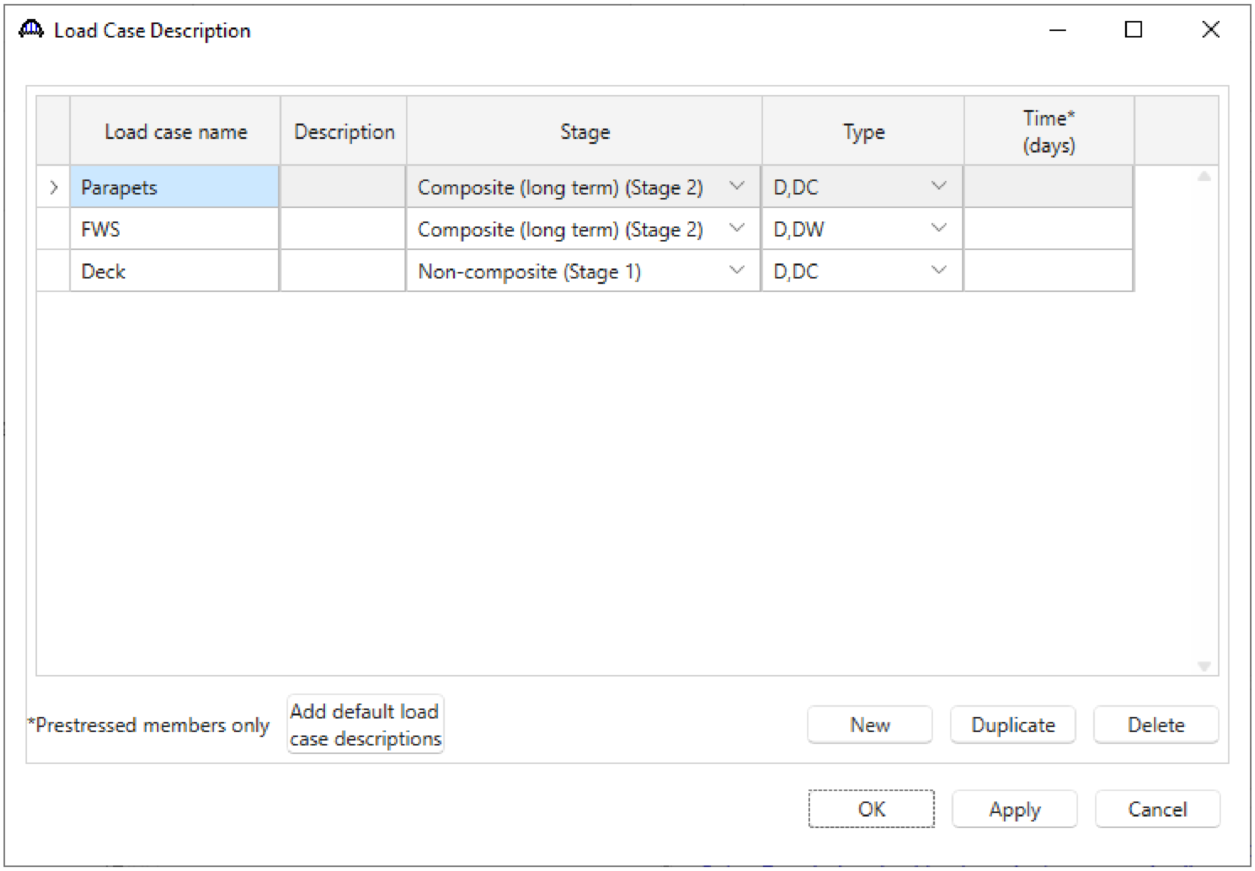
Superstructure Loads (Using Method 2 of adding member loads)

Method 2: Tell BrDR not to distribute the superstructure loads for us on the **Superstructure Loads** window for **6 Girder System**



Load Case Description

Compute the dead load on each girder system member due to the deck slab since it will not be computed by BrDR now. First create an additional Load Case Description for the deck slab. Open the **Load Case Description** window and add the following load case:

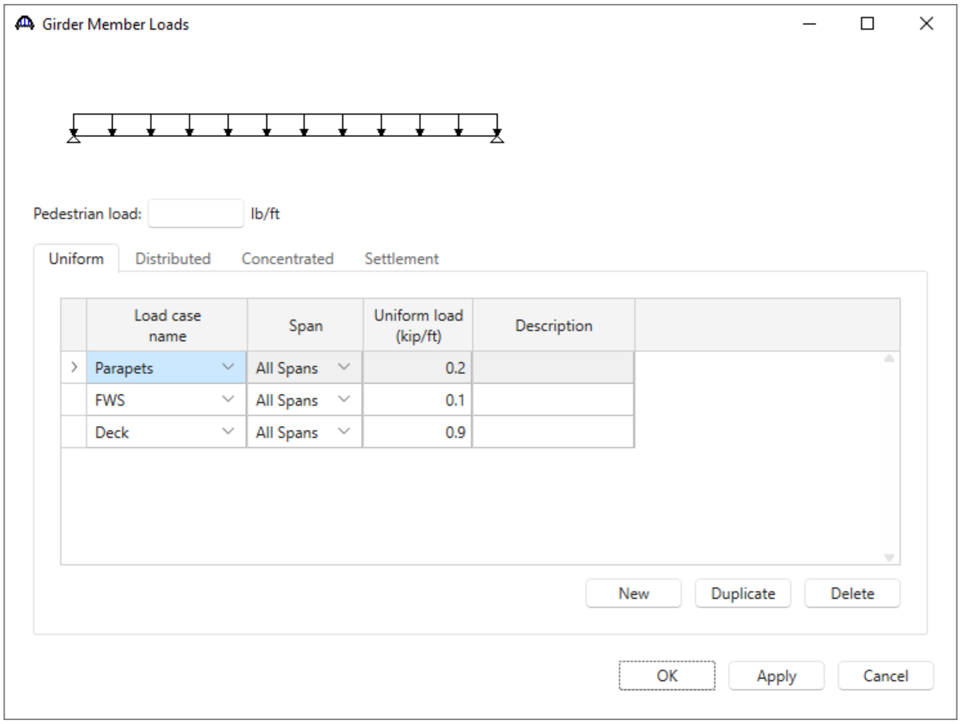


The deck slab dead load acting on Member **G2** is:

$$0.9k/ft = \left(\frac{8''}{12}\right)(9')(0.150kcf)$$

Girder Member Loads

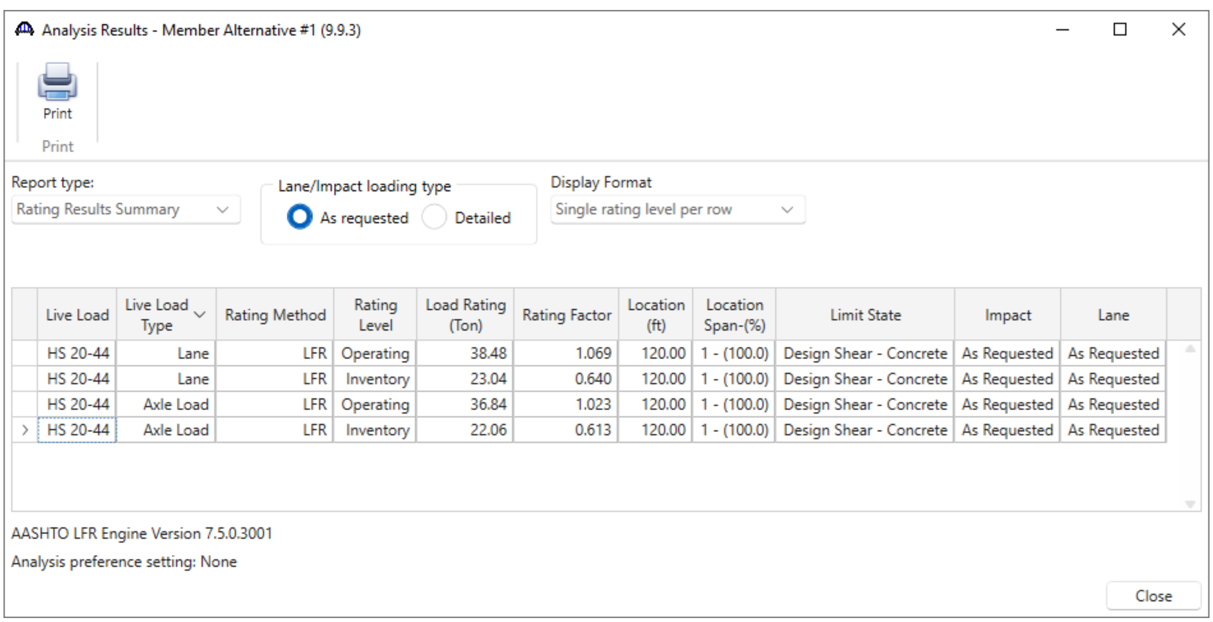
Open the **Member Loads** window and enter each of the following three load cases. The first two load cases are those that exist in the original girder line member.



Load case name	Span	Uniform load (kip/ft)	Description
Parapets	All Spans	0.2	
FWS	All Spans	0.1	
Deck	All Spans	0.9	

LFR Analysis – Results Comparison – (Using Method 2 of adding member loads)

Now analyze **Member G2** and get the same rating results as following Method 1.



Live Load	Live Load Type	Rating Method	Rating Level	Load Rating (Ton)	Rating Factor	Location (ft)	Location Span-(%)	Limit State	Impact	Lane
HS 20-44	Lane	LFR	Operating	38.48	1.069	120.00	1 - (100.0)	Design Shear - Concrete	As Requested	As Requested
HS 20-44	Lane	LFR	Inventory	23.04	0.640	120.00	1 - (100.0)	Design Shear - Concrete	As Requested	As Requested
HS 20-44	Axle Load	LFR	Operating	36.84	1.023	120.00	1 - (100.0)	Design Shear - Concrete	As Requested	As Requested
HS 20-44	Axle Load	LFR	Inventory	22.06	0.613	120.00	1 - (100.0)	Design Shear - Concrete	As Requested	As Requested